CLASSIFICATION AND GRADING THE LEVEL OF PADDY LEAF DISEASES USING MULTI CLASSIFIERS

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Abstract— Agriculture is the main backbone for most of the developing/developed countries; Agriculture production itself is the main feed for ever growing populations and it is the major source of income for the rural people/farmers especially in India. In India farmers are called "the backbone of India". The main aim of the proposed system is to detect and classify the diseases in paddy leafs. Paddy Diseases Classification comprises of two steps: first one is Detection, Extraction and Segmentation of diseases part by using Weiner, Adaptive histogram techniques as a pre-processing techniques, Two-Threshold Binary Decomposition by using Otsu algorithms for thresholding. Secondly, Feature extraction, Classification and Grade the level of disease by using boundary detection technique, Support Vector Machine (SVM) and Fuzzy logic classifiers respectively. In proposed system we are classifying three paddy leaf diseases by using above steps, the diseases we considered for classification are leaf blast, brown spot and Sheath blight. The proposed system has been experimentally tested for our own dataset and results achieved are encouraging.

Keywords— Otsu, SVM, Fuzzy Logic, Leaf Blast, Brown Spot, Sheath Blight.

I. INTRODUCTION

Agriculture is the main backbone for most of the developing/developed countries, Indian agriculture is known for its divergence which is mainly result of variation in resource, climate and historical, institutional and socio economic factors. The weather conditions, diseases and pests are major impact on yield and also the planning of harvest. Managing these unfavorable factors efficiently will leads to good crop yield and reduce the consequences.

One of the crucial components of crop yield management is accurate diagnosis and convenient solution of the agricultural problem. Performing diagnosis manually is a most challenging task and it is a function with few parameters like: environment, nutrient, organism etc. We can develop an automatic or semi automatic system to detect and classify the crop diseases; this is possible due to the recent achievements in image processing and also in pattern recognition

The proposed methodology of this paper is to identify the diseases in paddy leafs. Most common rice leaf diseases are [1],[2],[3],[4] leaf blast (Pyricularia oryzae), brown spot (Cochliobolus miyabeanus), Narrow-brown leaf spot (Cercospora oryzae), Sheath blight(Rhizoctonia solani), Leaf Scald (Microdochium oryzae), Leaf smut (Entyloma Oryzae), etc. Pramod et al. [5] addresses the automatic detection of crop diseases and circumstance that may affect crop yield and give the accurate solutions to the farmers instantly trough SMS by using pattern recognition and image processing techniques. Arti et al. [6] presents various image processing techniques to study leaf diseases. The methods studies to increase the throughput and to reduce the illusory result arising from human experts for detection of leaf diseases.

The general architecture to detect and classify the diseases in plant leaf is shown in Figure 1. Mainly there are five steps, Image Acquisition can be done either by capture from the digital camera, mobile cameras or by obtaining images from any other sources and extract the features.

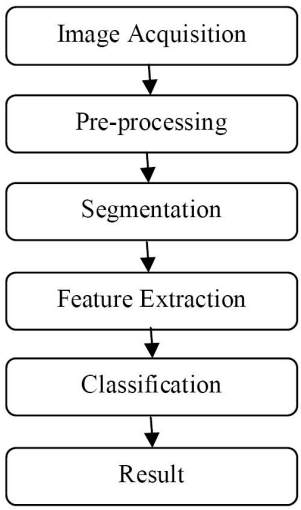

Figure 1: The general architecture for leaf disease Identification.

The proposed work consist of pre-processing technique used to enhance the quality of the image and then making use of SVM and Fuzzy Logic classifier to classify and grade the paddy diseases respectively. The segmented part of the image is given as the input to the SVM Classifier for the classification purpose. Thus, the system will able to timely diagnosis the field problem and the suggestion helps the farmer to take the appropriate measures to increase the quality of crops and reduce the development cost, which save the environment too.

II. PROPOSED SYSTEM

Paddy Diseases Classification comprises of two steps: 1) Detection, Extraction and Segmentation of diseases part, 2) Feature extraction, Classification and Grade the level of diseases. In proposed system we are classifying three paddy leaf diseases by using above steps, the diseases we considered for classification are leaf blast, brown spot and Sheath blight

A. Detection, Extraction and Segmentation of Diseases

Acquired images are enhanced by some pre-processing techniques like Weiner filter, Adaptive histogram to remove the blurriness and to enhance image by equalizing the pixel intensity value respectively.

Weiner filtering is used to reduce the noise from the given input image or to de-blur the image. Weiner filtering is one of the best filtering techniques to reduce the Gaussian noise, which we have applied on the gray scale image in order to remove the additional noise. The Figure 1(b) shows filtered image. The filtered image is given as the input to the adaptive histogram method. Adaptive histogram technique is used to enhance the contrast of the gray scale image. The Figure 1(c) shows the contrast enhanced image.

Thresholding is an important step in many computer vision tasks such as image segmentation, because the segmented image obtained from thresholding has the advantage of memory and low computational cost.

To decompose the input image we apply a technique with Two Threshold Binary Decomposition, Decomposition technique takes input as a gray-scale image, let I(x, y) be the input image and returns a set of binary images. Initial step of Two Threshold Binary Decomposition is to compute a set T, i.e., threshold values. The equal spaced gray-level values are selected to obtain the set of T threshold values. The multi-level Otsu technique is used to find the threshold that minimizes the input image intra class variance. Then, recursively, the Otsu algorithm is applied to each image region until unless the desired number of thresholds n_t is obtained, we are considering n_t value as 4. Here n_t is a user defined parameter.

The next step of the Two-Threshold Binary Decomposition algorithm consists in decomposing the input gray-scale image I(x; y) into a set of T binary images by applying following equation:

$$I_b(x,y) = \begin{cases} 1 & if\ t_l < I(x,y) \leq t_u \\ 0, & otherwise. \end{cases} \quad (1)$$

Where t_l and t_u denotes lower and upper threshold values respectively. The number of resulting binary images is $2n_t$, in our case $2n_t$ is 8. Figure 1(d) shows the decomposition of enhanced image using the Two-Threshold Binary Decomposition algorithm.

B. Feature extraction, Classification and Grade the level of diseases

The purpose of feature extraction is to reduce the image data by measuring some important features like mean, variance etc., of each segmented region such as colour, texture and shape.

In our work we have adopted boundary detection technique to detect the spots in the infected leaf image. Firstly we decide the structuring elements which define the points on the boundary of the spot. Then the segmented image and the structuring elements are eroded. Later we subtract the eroded image from the input image to obtain the boundaries of the spots in the image. After this, various features such as mean, variance, standard deviation, Smoothness, energy, Skewness, entropy, etc. are extracted. Here we have extracted thirteen features from the segmented image shown in TABLE I. The Figure 1(e) shows the boundaries of the infected part in the infected leaf.

For Classification and grading the level of diseases we are using SVM and Fuzzy logic classifiers respectively. Analyse and categorise the discrete properties of image features in to desire classes is the classification process. SVM is one among the classifier. Support Vector Machine is one among the different classifier which is used for classification purpose. There are two types in SVM, linear and nonlinear classifier. The non-linear classifier can able to classify features non-linearly. Introducing hyper plane in non-linear classifier, the feature vectors are differentiated in to various classes. Support vector is that based on the distance of hyper plane decide the feature vectors those are at the border of the class. The challenge is to train the support vector machine to understand structure or features from the data and mapping those structure with the right class label, for the better result consider the largest distance to neighboring training data points of class that is available in hyper plane.

The SVM classify function uses results from SVM trained data to classify vectors v by using following equation:

$$C = \sum_i \alpha_i k(s_i, v) + b \quad (2)$$

Where s_i is the support vectors, α_i is the weights, b is the bias, and k is the kernel function. If $c \geq 0$, then v is classified as a member of the first group, otherwise v is classified as a member of the second group.

In the process of classification, we divide the whole dataset into two types they are the training dataset and the testing dataset. The training dataset is a set of data whose features and characteristics are already known and it is used as a reference for comparison. Another type is the testing dataset, it is a set of data whose features are to be analysed and the diseases is to be classified. The SVM classifier compares the testing dataset with the training dataset to classify the input image into the desired class.

Fuzzy classifier is the process of grouping set of elements into a fuzzy by using the truth value of a fuzzy truth-function. A fuzzy class C = {i | Π(i)}, where C is defined as a fuzzy set of individual 'i' satisfying the fuzzy classification predicate Π which is a fuzzy truth-function. The area of the fuzzy class operator {.|.} is the set of variables V and the set of fuzzy propositional functions PF, and the range is the fuzzy power-set of universe, P(U):

$$\{ . | . \} : V \times PF \longrightarrow P(U) \quad (3)$$

$$\mu : PF \times U \longrightarrow T \quad (4)$$

Here, μ is a membership function, which indicates is individual is member of class or not, T is the set of fuzzy truth values, the truth values besides between zero and one.

The fuzzy classification predicate Π relates to a fuzzy restriction 'i' is 'R' of universe U, where R is a fuzzy set defined by a truth function. The degree of membership of an individual i in the fuzzy class C is defined by the truth value of the corresponding fuzzy predicate.

$$\mu C(i) := \tau(\Pi(i)) \quad (5)$$

By using these fuzzy logic rules classifies the diseases ,grade and percentage of infected paddy leaf.

III. EXPERIMENTAL RESULTS

To analyze the performance of proposed system, we have used our own dataset; it consists of total 200 paddy leaf images, in that 80 images belongs to brown spot diseases group in that 20 images are used for training purpose, 70 images belongs to Leaf Blast, in that 15 used for training purpose and remaining 50 images are Sheath Blight images in that 15 are used for training. In these 200 images we have used 50 images to train the SVM and Fuzzy logic classifier; remaining 150 images are used for testing and also for result analysis. Number of Truly detected disease images for Brown Spot, Leaf blast and Sheath blight are 56, 51 and 30 respectively.

The experimental results for brown spot, leaf blast and sheath blight is shown in Figure 1, Figure 2 and Figure 3 respectively. The accuracy of the proposed system is evaluated by using following equation:

$$Accuracy = \frac{No\ of\ truly\ detected\ Disease\ Images}{No\ of\ Images\ used\ for\ training} \quad (6)$$

The proposed methodology is compared with the existing approach [14] which was implemented by combining k-means and fuzzy logic classifier. We found that the proposed methodology has proved to obtain better classification shown in TABLE II.

Figure 1 (g), 2(g) and 3(g) indicates the grading and percentage of paddy leaf disease, Grading level and percentage of Img1-Brown Spot is 0.6 and 4.5% respectively. For Img2-Leaf blast 2.5 and 56%, for Img3-Sheath blight 1 and 13.5%. If the grading level is between 0-3, diseases can be curable, grading level above 3 indicates no cure for disease.

TABLE I. EXTRACTED FEATURES FROM INFECTED REGION

Features	Img1-Brown Spot	Img2-Leaf blast	Img3-Sheath blight
Mean	0.0775604	0.0360413	0.343781
SD	0.267481	0.186394	0.1822
Entropy	0.393524	0.223837	0.215893
RMS	0.272727	0.171725	0.130636
Variance	0.0708069	0.0343756	0.0304278
Smoothness	0.999803	0.999577	0.999556
Kurtosis	10.9773	25.7834	27.1239
Skewness	3.15868	4.97829	5.11116
IDM	58.7197	2.69704	46.9385
Contrast	1.27679	0.753615	1.49822
Correlation	0.817909	0.77922	0.5412.1
Energy	0.831523	0.915195	0903715
Homogenity	0.9772	0.986543	0.973246

TABLE II. PERFORMANCE ANALYSIS

Types of Diseases	Accuracy	
	K-means + Fuzzy Logic	SVM + Fuzzy Logic
Brown Spot	90.0%	93.33%
Leaf blast	87.27%	92.7%
Sheath blight	80.0%	85.71%

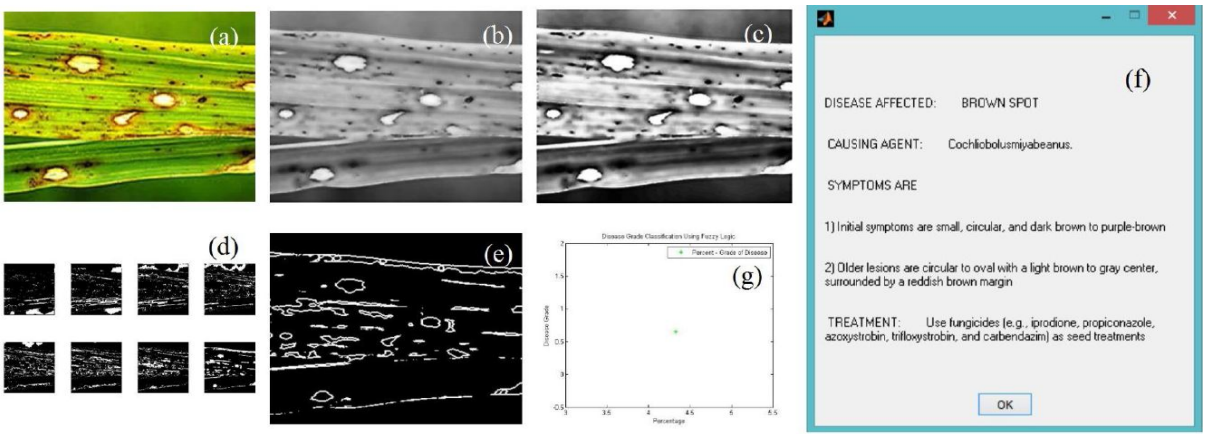

Figure 1: (a) Input Image [Brown Spot]; (b) Weiner Filtered Image; (c) Adaptive histogram; (d) Two-Threshold Binary Decomposed Image; (e) Adopted boundary detection; (f) Disease Classified as a Brown spot; (g) Grade and percentage of paddy leaf disease: x-axis indicates percentage, y-axis indicates level/grade of the disease.

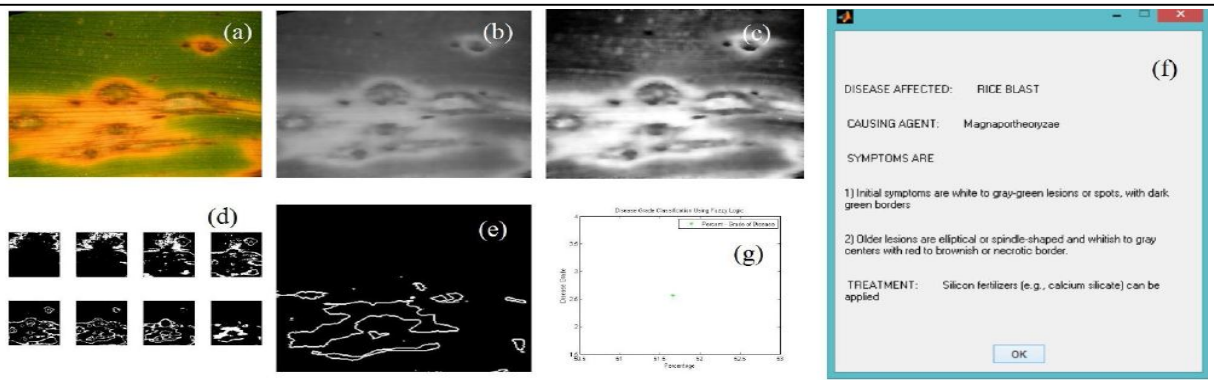

Figure 2: (a) Input Image [Rice Blast]; (b) Weiner Filtered Image; (c) Adaptive histogram; (d) Two-Threshold Binary Decomposed Image; (e) Adopted boundary detection; (f) Disease Classified as a Brown spot; (g) Grade and percentage of paddy leaf disease: x-axis indicates percentage, y-axis indicates level/grade of the disease.

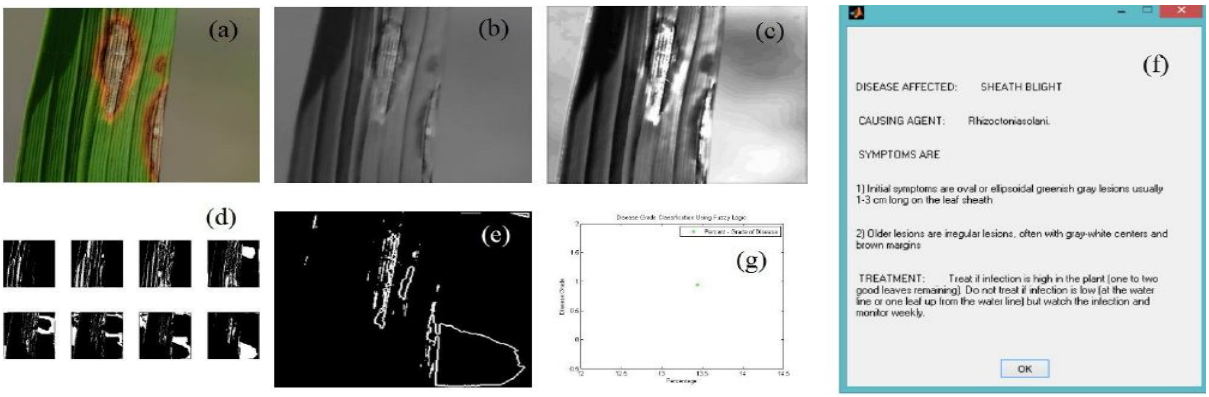

Figure 3: (a) Input Image [Sheath Blight]; (b) Weiner Filtered Image; (c) Adaptive histogram; (d) Two-Threshold Binary Decomposed Image; (e) Adopted boundary detection; (f) Disease Classified as a Brown spot; (g) Grade and percentage of paddy leaf disease: x-axis indicates percentage, y-axis indicates level/grade of the disease.

CONCLUSION

In this paper we have presented the classification and grade the paddy leaf diseases for Brown spot, Leaf blast and Sheath blight diseases by using Weiner, Adaptive histogram as a pre-processing techniques, Two-Threshold Binary Decomposition for thresholding, boundary detection technique like morphological operators are used to obtain the infected region and features like mean, variance, standard deviation, energy, entropy, etc., will be extracted and processed by using SVM and Fuzzy logic classifiers for disease classification and to grade the level of diseases respectively. The proposed system has been experimentally tested for 200 paddy leaf images and results achieved are encouraging. The research work can further be carried out to reduce the false classification by other robust pattern identification techniques considering the ample differences among the paddy leaf diseases.

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